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E.O. 12356: N/A

TAGS: TPHY, TNGD, TRGY, KNNP, KSCA, AR

SUBJECT: SOME BASIC RESEARCH AT BARILOCHE

1. SUMMARY. THE ATOMIC CENTER AND BALSEIRO INSTITUTE AT BARILOCHE, ARGENTINA, ARE PUBLICIZING THEIR WORK IN HIGH-TEMPERATURE SUPERCONDUCTORS IN THE HOPE OF WINNING INCREASED SUPPORT FOR THEIR BASIC RESEARCH PROGRAMS. THE ARGENTINE ATOMIC ENERGY COMMISSION (CNEA) OPERATES BOTH INSTALLATIONS IN SUPPORT OF LATIN AMERICA'S LARGEST NUCLEAR PROGRAM. THE PROGRAM, WHICH ENCOMPASSES THE ENTIRE NUCLEAR UNCLASSIFIED UNCLASSIFIED

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FUEL CYCLE, IS ONLY PARTLY UNDER INTERNATIONAL

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SAFEGUARDS SINCE ARGENTINA IS NOT A PARTY TO  
MULTILATERAL NONPROLIFERATION TREATIES.

2. THE CENTER AND INSTITUTE OPERATE MUCH AS A UNIT,  
WITH STUDENTS WORKING IN LABORATORIES AND RESEARCHERS  
TEACHING CLASSES. THE GREATEST EFFORT IS IN BASIC  
PHYSICS RESEARCH, WITH SMALLER PROGRAMS OF APPLIED  
RESEARCH AND NUCLEAR ENGINEERING. ABOUT 70 STUDENTS  
WORK WITH 100 RESEARCHERS. THE CENTER/INSTITUTE HAS  
GRADUATED ABOUT 300 PHYSICISTS SINCE ITS FOUNDING IN  
1955; ABOUT 70 HAVE RECEIVED DEGREES IN NUCLEAR  
ENGINEERING SINCE IT WAS ADDED TO THE CURRICULUM IN  
1977. (FROM INDEPENDENCE UNTIL 1955, ARGENTINA  
PRODUCED ONLY ABOUT 40 PHYSICISTS.)

3. SUPERCONDUCTIVITY RESEARCHERS HAVE DUPLICATED THE  
SWISS NOBELISTS' WORK AND ARE TRYING MANY NEW  
CERAMICS. A 500-KILOWATT RESEARCH REACTOR  
RA-6)

WENT INTO SERVICE IN 1982. TANGLED LINES OF  
AUTHORITY AMONG THE COMMISSION, THE CENTER, THE  
INSTITUTE AND THE CENTER'S INDUSTRIAL SPINOFF INVAP  
CONFUSE THE STRAIGHTFORWARD BASIC RESEARCH AND THE  
TRAINING GOALS OF BARILOCHE WITH THE COMMISSION'S  
SINGLE-MINDED PURSUIT OF AN INDEPENDENT NUCLEAR  
CAPABILITY. END SUMMARY.

INTRODUCTION

4. THE AWARD OF THE 1987 PHYSICS NOBEL PRIZE FOR  
WORK IN SWITZERLAND ON HIGH-TEMPERATURE  
SUPERCONDUCTORS HAS FOCUSED LOCAL ATTENTION ON THE  
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BARILOCHE ATOMIC CENTER, A NATIONAL LABORATORY OF THE  
ARGENTINE ATOMIC ENERGY COMMISSION (CNEA), LOCATED IN  
AN AREA OF LAKES AND MOUNTAINS 1000 MILES SOUTHWEST  
OF BUENOS AIRES. FOR IT WAS HERE IN FEBRUARY THAT  
ARGENTINE PHYSICISTS DUPLICATED THE DECEMBER WORK  
CARRIED OUT BY THE NOBEL PRIZE WINNERS FROM IBM'S  
ZURICH LABORATORY. THEN IN MARCH THEY MATCHED  
FURTHER WORK ACHIEVING SUPERCONDUCTORS FUNCTIONING AT  
THE HIGHEST TEMPERATURES YET ACHIEVED.

5. THE FEVER PITCH OF THEIR WORK SINCE HAS PERHAPS  
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ONLY BEEN MATCHED BY THE INTENSITY OF THE CENTER'S OWN PUBLICITY CAMPAIGN -- FIRST TO DRAW NATIONAL ATTENTION TO THEIR WORK AND SECOND TO AUGMENT THE MEAGER RESOURCES ALLOTTED TO BASIC RESEARCH AT THE CENTER BY THE PARENT COMMISSION. WHILE THE SUPERCONDUCTIVITY WORK ITSELF MADE A RECENT VISIT TO THE CENTER INTERESTING, IT IS PERHAPS WORTH REVIEWING AND UPDATING THE ROLE OF THE CENTER IN THE MAIN BUSINESS OF CNEA, DEVELOPING SOUTH AMERICA'S LARGEST NUCLEAR CAPABILITY. THIS CAPABILITY EXTENDS TO THE ENTIRE NUCLEAR FUEL CYCLE AND IS IN CONSIDERABLE PART OUTSIDE OF THE INTERNATIONAL SAFEGUARDS AND INSPECTION REGIME ACCEPTED BY PARTIES TO THE 1968 NUCLEAR NONPROLIFERATION TREATY.

FOUNDING

-----  
6. FACED WITH AN ACUTE SHORTAGE OF PHYSICISTS AFTER ITS FOUNDING IN 1950 TO DEVELOP ARGENTINA'S NUCLEAR PROGRAM, CNEA SET UP AT SAN CARLOS DE BARILOCHE (RIO NEGRO PROVINCE) IN 1955 BOTH THE BARILOCHE ATOMIC CENTER FOR RESEARCH AND AN INSTITUTE FOR TEACHING ON THE SAME 180-ACRE CAMPUS. FROM INDEPENDENCE EARLY IN

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TAGS: TPHY, TNGD, TRGY, KNNP, KSCA, AR  
SUBJECT: *SOME BASIC RESEARCH AT BARILOCHE*

*THE 19TH CENTURY TO 1955, THE COUNTRY HAD PRODUCED  
ONLY 40 PHYSICISTS.*

7. THE INSTITUTE, NOW CALLED THE BALSEIRO INSTITUTE  
AFTER ITS FIRST DIRECTOR, IS OFFICIALLY PART OF THE  
NATIONAL UNIVERSITY OF CUYO IN MENDOZA, FAR TO THE  
NORTH. THE CENTER AND THE INSTITUTE OPERATE MUCH AS  
A UNIT, WITH RESEARCHERS TEACHING COURSES AND  
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STUDENTS WORKING IN THE LABORATORIES. THE ORIGINAL  
CURRICULUM WAS PHYSICS; NUCLEAR ENGINEERING WAS ADDED

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IN 1977. ABOUT 30 STUDENTS ENTER THE INSTITUTE ANNUALLY AFTER TWO YEARS OF TRAINING ELSEWHERE AND STUDY FOUR MORE YEARS FOR THE LICENCIATURA (MASTER'S DEGREE), WHICH REQUIRES A THESIS. FOUR MORE YEARS OF STUDY LEAD TO THE DOCTORATE; HALF THE PHYSICISTS GO ON FOR IT. EIGHTY PERCENT OF ALL GRADUATES STAY IN ARGENTINA, HALF WORKING FOR CNEA. SINCE 1955 THERE HAVE BEEN OVER 300 MASTER'S DEGREES IN PHYSICS AWARDED. NUCLEAR ENGINEERING DEGREES SINCE 1977 NUMBER ABOUT 80.

## PROGRAM

8. THE FOLLOWING CHART SUMMARIZES THE WORK OF THE DIFFERENT DEPARTMENTS AND THE SCALE OF EFFORT.

DEPARTMENT	SCIENTISTS	STUDENTS
BASIC RESEARCH		
-- LOW TEMPERATURES	8	7
-- ATOMIC COLLISIONS	15	14
-- METALS	7	5
-- NEUTRONS AND REACTORS	8	3
-- MAGNETIC RESONANCE	6	5
-- THEORY - ELEMENTARY PARTICLES	6	9
-- THEORY - SOLIDS	10	7

## RELATIVITY, GRAVITATION

- AND UNIFIED THEORIES

1	1
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61	51
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## APPLIED RESEARCH

-- DEVELOPMENT	2	3
-- CERAMICS AND INDUSTRIAL CARBONS	5	3
-- METALLURGY	11	4
-	---	---
-	18	10
-	---	---

## NUCLEAR ENGINEERING

-- THERMOHYDRAULICS	5	8
-- COMPUTATIONAL MECHANICS	4	2
-- SAFETY AND PROTECTION	1	0

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-- REACTOR CONTROL	2	0
-- RESEARCH REACTOR RA-6	13	1
-	----	----
-	25	11
-	----	----
TOTALS	104	72

CURRENT FIGURES MAY TOTAL SOMEWHAT LOWER. EMPHASIS ON SUPERCONDUCTIVITY IS LEADING TO EXPANSION OF THE LOW-TEMPERATURE AND DEVELOPMENT GROUPS.

9. IN ADDITION, DURING 1985, ABOUT 40 VISITING SCIENTISTS SPENT TIME WITH BASIC RESEARCH GROUPS AT BARILOCHE. EIGHT WERE FROM THE UNITED STATES. AT PRESENT THE CENTER/INSTITUTE HAS CLOSEST TIES TO FRANCE (UNIVERSITY OF GRENOBLE), BRAZIL, GERMANY AND SPAIN. NEVERTHELESS, OLD-TIMERS GRATEFULLY REMEMBER THE CONTRIBUTION MADE TO THE ORGANIZATION AND PROGRAM OF THE CENTER BY U.S. LOW-TEMPERATURE SCIENTIST JOHN WHEATLEY, WHO CAME TO BARILOCHE AS A FULBRIGHT RESEARCH SCHOLAR FROM THE UNIVERSITY OF ILLINOIS IN 1962-3.

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***FACILITIES AND SOME PROJECTS***

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10. AN OPEN-STACK LIBRARY CONTAINS 12,000 BOOKS AND  
SUBSCRIBES TO 300 JOURNALS. A VAX 780 COMPUTER IS  
SUPPLEMENTED BY NUMEROUS DESKTOPS AND ON-LINE UNITS.  
THE CENTER MAKES ALL OF ITS OWN LIQUID AIR, NITROGEN,  
OXYGEN AND HELIUM.

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11. SUPERCONDUCTIVITY: DRAWING MAINLY ON THE

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LOW-TEMPERATURE AND DEVELOPMENT DIVISIONS, THE SUPERCONDUCTIVITY EFFORT HAS PRODUCED 12 ARTICLES SUBMITTED FOR PUBLICATION SINCE FEBRUARY 1987, EIGHT OF WHICH HAVE ALREADY BEEN ACCEPTED. MANY CONCERN THE PHENOMENON IN INHOMOGENEOUS MEDIA CONTAINING RARE EARTHS, THORIUM AND/OR TRANSITION ELEMENTS. ONE STARTING POINT IS AN ALLOY OF OXIDES OF YTTRIUM OR GADOLINIUM), COPPER AND BARIUM FIRST OBTAINED IN SWITZERLAND AND DUPLICATED IN BARILOCHE IN MARCH. AN ALLOY THAT IS SUPERCONDUCTING AT ABOUT 90 DEGREES ABSOLUTE. THIS TEMPERATURE IS, OF COURSE, MUCH EASIER TO OBTAIN THAN THE RECORD HIGH OF 20 DEGREES BEFORE 1986.

12. EFFORTS ARE UNDERWAY TO FIND NEW ALLOYS AND ALSO TO MASTER THE FABRICATION OF CURRENT-CARRYING FILMS AND WIRES. WITHOUT THEM THERE CAN BE NO USE OF THE NEW SUBSTANCES. THE SCIENTISTS ARE REALISTIC ABOUT APPLICATION OF THE RESEARCH BY ARGENTINE INDUSTRY -- IT PROBABLY WON'T HAPPEN. ONE SAID THE MOST ARGENTINA COULD EXPECT WOULD BE TO BE ABLE TO BUY FOREIGN SUPERCONDUCTING TECHNOLOGY APPLICATIONS MORE WISELY RATHER THAN IN THE MANNER OF MIRRORS AND GLASS NECKLACES. BUT MOST HOPE THAT BARILOCHE WILL AT LEAST GET A BUDGET INCREASE. (FRANCISCO DE LA CRUZ HEADS THE LOW-TEMPERATURE GROUP, AND DANIEL ESPARZA LEADS THE DEVELOPMENT GROUP.)

13. NUCLEAR RESEARCH: THE MOST VISIBLE NUCLEAR RESEARCH AT BARILOCHE CENTERS ON THE TEST REACTOR RA-6. OF 500-KILOWATT POWER, RA-6 IS ARGENTINA'S  
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NEWEST RESEARCH REACTOR, IN OPERATION SINCE 1982. IT USES FUEL ENRICHED TO 20 PERCENT URANIUM-235. OPERATION IS SUBJECT TO INTERNATIONAL SAFEGUARDS ONLY WHEN IT'S LOADED WITH SAFEGUARDED FUEL. (\*) WAS DESIGNED AT THE CENTER AND BUILT BY INVAP S.E., AN INDUSTRIAL SPINOFF OF THE CENTER DATING FROM 1976, HALF OWNED BY CNEA AND HALF BY THE PROVINCE OF RIO NEGRO. (\*)

SHORT FOR APPLIED RESEARCH) BUILT RA-6 AS AN EXPORT PROTOTYPE. INVAP ALSO BUILT THE URANIUM DIFFUSION ENRICHMENT PLANT UNVEILED AT NEARBY

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PILCANIYEU IN 1983 THAT IS NOT OPEN TO INTERNATIONAL INSPECTION. (PROPERLY ENRICHED URANIUM CAN, OF COURSE, BE USED IN NUCLEAR EXPLOSIVES.)

OTHER ASPECTS OF NUCLEAR DEVELOPMENT

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14. THE ORGANIZATION OF CNEA, THE ATOMIC CENTER, THE BALSEIRO INSTITUTE AND INVAP COMPLICATES ANY CONSIDERATION OF THE CENTER AND INSTITUTE AS SIMPLE ESTABLISHMENTS FOR BASIC RESEARCH AND EDUCATION. CNEA, FORMED IN 1950, NOW HAS 6500 EMPLOYEES. NUCLEAR PROGRAMS USED UP TO 2.5 PERCENT OF THE ANNUAL GNP FROM 1973-83, UP TO ONE BILLION DOLLARS A YEAR. CLOSELY LINKED TO THE NAVY AND WITH NAVY MEN AS DIRECTORS FOR 30 OF ITS FIRST 33 YEARS, THE COMMISSION REMAINED CIVILIAN IN NATURE BUT WITH IMPORTANT PROTECTION. ITS PURSUIT OF PROFESSIONALISM HAS BEEN ALONG A SINGLE CHANNEL -- NUCLEAR DEVELOPMENT. AFTER 1978 THIS MEANT DEVELOPMENT OF THE ENTIRE NUCLEAR FUEL CYCLE -- INDEPENDENTLY, EXPENSIVELY AND, AT TIMES, SECRETLY. IF CNEA NEEDED A GOOD RESEARCH CENTER AND A SCHOOL FOR PHYSICISTS, IT MADE IT. IF IT NEEDED ENRICHED URANIUM, IT HAD

NOTE BY OC/T: (\*)OMISSIONS; CORRECTIONS TO FOLLOW.  
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SUBJECT: *SOME BASIC RESEARCH AT BARILOCHE*

*INVAP BUILD A DIFFUSION PLANT AT PILCANIYEU, NEAR  
BARILOCHE.*

15. THE CONFLICT OF AUTHORITY AT BARILOCHE WAS  
EVIDENT FROM THE BEGINNING, FOR THERE WAS A NAVY MAN  
AS HEAD OF THE CENTER, AND A CIVILIAN SCIENTIST TO  
RUN THE INSTITUTE. THE PRESENT DIRECTOR  
DR. ARTURO

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LOPEZ DAVALOS) IS THE FIRST TO HEAD BOTH. STUDENTS  
IN THE PAST HAVE CHAFED UNDER THE OBVIOUS

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NONEDUCATIONAL ACTIVITIES. THE 1985 CLASS VALEDICTORIAN SHOCKED THE AUDIENCE WITH HIS CRITICAL COMMENTS.

16. AT LEAST THE SCIENTISTS IN FIELDS FARTHEST FROM THE NUCLEAR AREA CONTINUE ON LIKE SCIENTISTS ANYWHERE, LOOKING FOR THE BEST STUDENTS, HAGGLING OVER NEW SPACE, TALKING THE DIRECTOR OUT OF MONEY FOR EXTRA EQUIPMENT AND ANGLING TO GET TO INTERNATIONAL MEETINGS. THEY AND THEIR PREDECESSORS HAVE HAD A PROFOUND AND PERMANENT EFFECT ON ARGENTINA'S SCIENCE (MAINLY PHYSICS), ITS RESEARCH PHILOSOPHY AND ITS EDUCATION. U.S. SCIENTISTS CAN AND DO FIND MUCH TO ADMIRE AND LEARN AT BARILOCHE; IT'S WORLD-CLASS.

GILDRED

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